Site Selection Study

Newfoundland LNG Ltd.
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Business Overview

Business Strategy:

Newfoundland LNG Ltd. proposes to develop a Liquefied Natural Gas (LNG) Transshipment and Storage Terminal to provide low-cost, high availability LNG transshipment and storage capacity to potential clients. The Grassy Point LNG Transshipment and Storage Terminal (the “Project”) will provide facilities for LNG cargo transfer, temporary vessel-based LNG storage and a demurrage site for in-transit LNG carriers. The marine facility will enable larger vessels to offload their cargo and commence the return voyage.

Over three major Project phases, the Project will involve the construction and operation of:

- three jetties with berthing capability for LNG takers up to 265,000 m$^3$;
- a tugboat basin;
- eight LNG storage tanks; and
- supporting infrastructure including an access road, office facilities and security fencing.

The storage tanks will have up to 160,000 m$^3$ capacity. The tanks and interconnecting piping will be located on land, adjacent to the marine facilities. There will be no initial requirement for a re-gasification facility.

The construction of the three berths will be phased in over the duration of the Project. The berths will extend to a water depth of approximately 15m and will not require dredging. A single berth will be constructed initially followed by additional berths as the LNG demand increases. Each berth will be similar in construction and will consist of a service platform, mooring dolphins, berthing dolphins, access trestle connecting the loading platform to shore and walkways connecting the mooring and berthing dolphins. The service platform will be equipped with fixed loading arms to facilitate loading and unloading of LNG product.

A dedicated tug basin will also be incorporated into the works. This basin will require a minimum of 6 m water depth and be capable of berthing two to three tugs. During the construction phase, the tug basin will also serve as an offloading point for construction supplies.

The Grassy Point LNG Transshipment and Storage Terminal design has a Boil Off Gas (BOG) re-liquefaction system to manage all potential BOG created within vessels from stored LNG, the BOG created due to transshipment operations (pumps, long pipe runs, valve and fittings heat gain) and the BOG generated from land-based storage tanks. Initially, all BOG generated from storage and/or transshipment operations will be re-liquefied and returned to storage utilizing a land-based re-liquefaction system.

The expected Project life of the Grassy Point LNG Transshipment and Storage Terminal is 50 years.
The Grassy Point LNG Transshipment and Storage Terminal (the “Project”) will be owned and operated by Newfoundland LNG Ltd., a Newfoundland and Labrador corporation. The purpose of the Project is to provide Atlantic Basin LNG supply-chain solutions through development of strategic transshipment and storage facilities. The Government of Newfoundland and Labrador has stated its desire to establish the Province as an “Energy Warehouse” and the construction of a LNG terminal contributes to the critical mass of energy infrastructure in the province. The demand for natural gas in has increased since the 1980s due to:

- increased energy requirements;
- the desire to diversify energy resources;
- the environmental advantages of natural gas over other fossil fuels; and
- its superior thermal efficiency when used for electricity generation.
Ownership Entities

Overview of Entities:

Newfoundland LNG Ltd.
A Canadian corporation formed in 2000
100%

Newfoundland LNG Ltd.

Newfoundland LNG Ltd. is a Newfoundland & Labrador registered company formed in 2000. The Company is focused on providing global LNG supply chain solutions through its proposed transshipment and storage facilities in Newfoundland.
Site Selection Analysis

Site Alternatives – Site Selection Criteria:

During 2000-2001, NLNG assembled a technical team that conducted an initial site selection study to identify potential Newfoundland locations for transshipment and storage. The study was further updated to include potential Nova Scotia sites in the Spring of 2005.

Key requirements for the proposed terminal are presented below.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanker sizes to be accommodated</td>
<td>140,000 m³ – 265,000 m³</td>
</tr>
<tr>
<td>Tankers per year</td>
<td>Minimum of 200</td>
</tr>
<tr>
<td>Number of berths needed</td>
<td>One for ship to ship (STS) and two for concurrent transshipments, demurrage and temporary storage</td>
</tr>
<tr>
<td>LNG storage volume required at the terminal</td>
<td>Up to 1.1 million m³</td>
</tr>
<tr>
<td>Marine/Navigation needs</td>
<td>Unobstructed movement during normal winter ice conditions minimum 15 m depth throughout shipping channel manoeuvring area and at berth. A wide straight approach to the berth, berth sheltered from prevailing weather conditions at least two ship lengths turning basin near berth.</td>
</tr>
</tbody>
</table>

The site selection study involved a systematic review of the entire North Atlantic region. The requirements for a site to pass the initial screening consisted of the following:

- An area free of ice under normal winter conditions;
- Sufficient water depth to permit safe transit to and from the location by the largest tankers;
- An area with harbour potential, that is, generally sheltered from the effects of the prevailing weather conditions; and
- An area accessible from the existing road system without major road construction.

The presence of either icebergs or pack-ice along the north, west and east coasts of Newfoundland, as seen in the following map, eliminated them from further consideration. The extreme east and west ends of the south coast also have unacceptable occurrences of pack ice and/or icebergs and they too were eliminated. The only sub-regions that passed the initial screening process were Fortune Bay, Placentia Bay and St. Mary’s Bay, Newfoundland, as well as the Straits of Canso, Nova Scotia.
The locations passing the initial screening were evaluated as potential harbours in the next stage of screening. This involved their assessment with respect to:

- Marine access (the relative ease or difficulty of navigating an LNG tanker to the tentative jetty location);
- Harbour potential (shelter, availability of a suitable turning basin immediately adjacent to the jetty);
- Land access;
- Land area (the availability of sufficient crown land or municipally owned land for facility development adjacent to the marine facilities); and
- Land elevation (approximately 30 to 40 m above sea level).

This screening narrowed the potential sites down to seven: Come-by-Chance, Placentia Bay; Admirals Beach, St. Mary’s Bay; Long Harbour, Placentia Bay; Goldboro, Nova Scotia, Point Tupper Flat Head, Nova Scotia; Point Tupper Bear Head, Nova Scotia and Grassy Point, Placentia Bay.
These seven potential sites were then evaluated with respect to:

- Marine operations;
- Physical and biological environment;
- Regulatory and socio-economic environment; and
- Cost and schedule.

This evaluation included the participation of the following disciplines:

- Archaeology;
- Commercial fisheries;
- Geology;
- Marine mammals;
- Vegetation, parks and historic resources;
- Fish habitat; and
- Socio-economics.

**Description of Potential Sites:**
Come By Chance, Newfoundland

The Come By Chance terminal site is adjacent to the existing North Atlantic Refinery Ltd. oil refinery, approximately 3 km South of the community of Come By Chance and within the town’s municipal planning area. The vicinity has been extensively developed for industrial use and most of the natural peat surface has been removed. There are several access roads around the site.

Come By Chance is in Placentia Bay and the seaward approaches are reasonably sheltered from both winds and waves from all directions, except from the South and Southwest. In these directions, maximum fetch is still limited and complicated by the islands of Placentia Bay so that fully developed ocean swells are not possible. Tankers can turn in a turning basin adjacent to the potential berth or in a more exposed area to the south of the existing terminal. The route along Placentia Bay to the terminal is controlled by an existing vessel traffic system operated by CCG. Suitable navigational aids are already in place.

On the seaward side, the jetty is located to the north of the existing jetty and is connected to an existing causeway by a trestle approximately 200 m long. Additional jetties could be constructed on the south end of the existing jetty or a berth could be constructed on the shore side of the potential north jetty. The tank farm location is approximately 500 m north of the existing refinery. Expansion of the tank farm can be achieved by placing additional tanks to the north.

The near shore area at the terminal site is less than 10 m deep for a distance of about 800 m from the beach. Water depths increase quickly after that. To avoid this large shallow area, the existing refinery jetty, which would be the basis for the transhipment terminal jetty, is built at the end of a long rock-fill causeway so that the tanker depths are close to the middle of Come By Chance Bight.

The shoreline at the Come By Chance site is a mixture of low bedrock platforms with intermediate gravel or cobble beaches. The backshore consists of a mixture of low grassy flats, unconsolidated banks and bedrock cliffs. The landward portion of the site is a gently rolling hillside with elevations ranging from 25 to 40 m. Future expansion could continue to the north of the initial terminal site.

Come By Chance is a federal harbour administered by DOT. The onshore lands are provincial crown land.

Admirals Beach, Newfoundland

The Admirals Beach site is located approximately midway between the communities of Admirals Beach and O’Donnells on the east side of St. Mary’s Bay. The site is undeveloped and immediately adjacent to the coastal road to the community of Admirals Beach.
The seaward approach to the site is relatively simple. Although there are no established traffic lanes and few navigational aids, there is sufficient room for manoeuvring. Anchorage could be provided for up to two tankers near the terminal. The site is sheltered from ocean swells by Great Colinet and Little Colinet Islands to the south and west.

The Admirals Beach site is divided by the coastal road. A terminal built on this site would require the marine facility to be on the seaward side and the tank farm on the landward. The beach is composed of unconsolidated gravel cobble interspersed with sedimentary bedrock outcroppings extending into the sub tidal levels. It slopes gently and has an unconsolidated backshore bank stabilized by mixed grasses above the beach and thick alders and spruce behind. Behind the roadway, which is at an elevation of about 15 m, the topography continues a gentle slope inland to an elevation of 30 to 40 m at the inland extent of the potential terminal site. The land on the landward side of the road is mixed bog and grass with large thickets of low spruce forest.

The coastline is long and straight in this area with no apparent obstructions to construction of the offshore facilities or for ship’s manoeuvring. Any future expansion of the facility would likely be parallel to the shoreline because of the steeply-sloped terrain in the area. Both the marine and onshore lands are provincial crown land.

**Long Harbour, Newfoundland**

The Town of Long Harbour and Mount Arlington Heights is located on the south-western portion of the Avalon Peninsula. It is located on the east side of Placentia Bay. It is 105 km (60 miles) from the province’s capital, St. John’s.

With the infrastructure that remains in place, the Long Harbour Industrial Site has potential for fabrication, construction, maintenance and supply base work. The site’s deepwater, ice-free port and docking facilities can accommodate all types of large marine vessels.

Long Harbour and Mount Arlington Heights is a small rural community. For the first 500 years of its existence, the fishing industry was the main economic activity of the town. That changed dramatically in 1968 when ERCO (now Rhodia Canada Inc.) established a world-scale phosphorus reduction plant in the Town. The plant operated for 21 years before closing down in 1989. At its peak, the plant employed upwards of 700 people.

The site’s dock can accommodate ships up to 70,000 DWT, with drafts over 10 metres (33 feet). The dock, which continues to be inspected on an annual basis, is in excellent condition. Its large concrete caissons support a concrete deck to give substantial loading capacity. For years, the dock regularly accommodated ships up to 950 feet in length.
Specific information on individual berths is summarized in the table below:

<table>
<thead>
<tr>
<th>Berths</th>
<th>Length (m)</th>
<th>Width (m)</th>
<th>Depth (m)*</th>
<th>Load (kPa)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>204</td>
<td>19.2</td>
<td>13</td>
<td>14.4</td>
</tr>
<tr>
<td>2</td>
<td>198</td>
<td>19.2</td>
<td>13</td>
<td>14.4</td>
</tr>
<tr>
<td>3</td>
<td>160</td>
<td>19.4</td>
<td>10</td>
<td>14.4</td>
</tr>
</tbody>
</table>

* Water depth at lowest normal tide

Bollards of 150 tonne capacity and heavy-duty marine fenders are distributed along the full length of the berths. A mooring dolphin (11 m by 11 m) is located at the head of the dock. Fire and domestic water supply, in addition to electrical services are installed.

**Point Tupper, Nova Scotia**

Point Tupper is in Richmond County on the Cape Breton side of the Strait of Canso. Historically, Point Tupper, which is on the edge of the Town of Port Hawkesbury, has been a location for light and heavy industry, such as the Stora Enso paper mill (1959), the Nova Scotia Power Plant (1968), the Propane Storage Project in Salt Domes (proposed 1979), the Venture Offshore Gas Plant (proposed 1985), the Scotia Synthfuel Storage Terminal (1993) and StatiaTerminals Group NV’s oil transshipment and storage facility (1996). The Point Tupper area has several industrial parks and business parks for manufacturing, storage, transportation and office activities.

The Point Tupper area has several zoning categories: general industrial, heavy industrial, open space, and rural development. In addition to associated uses, the light industrial and heavy industrial zoning categories allow residential uses with their required provisions of parking, yard and buffer zones. The Bear Head lot is reasonably level, while the abutting property at Flat Head has the required water depth close to shore. The two lots will have to be consolidated to provide an adequate property for construction. Bear Head, which has a beach and wetland area at its eastern end, is zoned Open Space, while Flat Head, to the west of Bear Head is part of the Point Tupper Heavy Industrial Zone. Anadarko Petroleum Corporation intends to construct an LNG Terminal to receive, store and regasify LNG delivered from the Atlantic Basin and shipped to market via the Maritimes and Northeast Pipeline (M&NP). Statia Terminals NV has substantial infrastructure for the transshipment and storage of oil including a tank farm and related marine facilities.

Bear Head and Flat Head benefit from 6 to 8 feet of overburden over sedimentary rock. Land levelling required for development appears to be reasonable, especially at Bear Head. Soils at Point Tupper are fine textured; therefore, there is erosion potential for lands on high slopes. Near shore water depth adjacent to Bear Head is modest. It is necessary to go out 400 to 500 metres to reach the six fathom depth. At Flat Head, shore side slopes are more extreme and the land is more rugged, but six fathoms of depth can be reached within about 200 metres off the shore.
The Municipal Planning Strategy and Land Use Bylaw for the area require at least 15 metres separation between a developed site and any watercourse so as to protect fish habitat and water quality. Surface water at Bear Head and Flat Head is relatively shallow. Vegetation consists of mature and immature forests that require protection, but each site has different needs in these respects. In particular, Bear Head has extensive wetlands that will require studies as a component of an environmental impact assessment for any potential development.

Marine access to Point Tupper benefits from the deep, ice-free waters of the Strait, which provide direct access to international and coastal shipping routes, and sufficient water to accept very large ocean carriers. Road infrastructure in the area is adequate and there are preliminary plans for upgrades and improvements. Route 4, Highway 104, Port Malcolm Road and Trunk 4 are the main arteries in the area. Traffic circulation problems are a recognized constraint. Bear Head is approximately 2.5 to 3 km from existing paved roads.

Rail facilities near the Point Tupper site will need to be improved, with an additional rail yard and associated facilities. A rail spur has recently been built to service the fractionation plant operated by Sable Offshore Energy Incorporated. There is also a rail line at Statia Terminals.

**Grassy Point, Newfoundland**

The Grassy Point site is located on the eastern shore of Placentia Bay, about 8 km south of the North Atlantic Refinery at Come By Chance and adjacent to the Newfoundland Transshipment Limited (NTL). As it is selected as the preferred site for the transshipment terminal, it is described in greater detail. The approaches to Grassy Point are reasonably sheltered from both winds and waves from all directions, except from the south and southwest. Even for these directions, maximum fetch is limited and complicated by the islands of Placentia Bay so that the development of full ocean swells is not possible. As the site is outside of Come By Chance Bight, tankers could turn easily adjacent to the jetty or further to the northwest, west or southwest. The route along Placentia Bay to the proposed terminal is controlled by an existing vessel traffic system operated by the Canadian Coast Guard. Suitable navigational aids are already in place along this route.

**Selection of Grassy Point as the Preferred Site:**

All seven sites rated very closely in the technical evaluation; however, there are important shortcomings in certain areas. The following section highlights the strengths and weaknesses of each site under key attributes and illustrates Grassy Point as the optimal site.
## Water Depth

- Flat Head offers sufficient water depth proximate to shore but is complicated by limited adjacent land area with reasonable elevation. Bear Head offers reasonably contoured land but is not immediately proximate to deep water.
- Long Harbour will need considerable dredging to increase water depth to acceptable levels. Additionally, a sunken vessel needs to be cleared from the inside berth of the finger pier, adding a costly component to completion.

## Harbour Potential

- The three sites in Placentia Bay, Long Harbour, Come By Chance, and Grassy Point, all share the favourable sea conditions of the immediate area. These include minimal tidal and wave conditions, and large shipping lanes. Among the three, Come By Chance and Long Harbour have more limited manoeuvrability due to more robust existing traffic or more narrow water ways.
- Admiral’s Beach in St. Mary’s Bay does not share the same placidity in sea conditions as Placentia Bay and thus does not offer as strong a harbour potential.
- Point Tupper on the Straight if Canso has extreme tidal conditions with typical conditions approaching 2 meters. That combined with substantial shipping congestion due to activity at the Statia Terminals facility would create poor manoeuvrability.

## Infrastructure

- The three Placentia Bay sites again have an advantage in their close proximity to bunkering services, tugs and pilots, emergency and support services, and a CCG vessel-traffic monitoring remote-radar facility. Due to the nearby communities, waste management and

### Table: Site Comparison

<table>
<thead>
<tr>
<th>SITE</th>
<th>ICE FREE</th>
<th>WATER DEPTH</th>
<th>HARBOUR POTENTIAL</th>
<th>INFRASTRUCTURE</th>
<th>LAND AREA</th>
<th>ENVIRONMENTAL CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEWFOUNDLAND</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Come-by-Chance</td>
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<td>*</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Admiral’s Beach</td>
<td>***</td>
<td>***</td>
<td>*</td>
<td>*</td>
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<td>***</td>
</tr>
<tr>
<td>Long Harbour</td>
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</tr>
<tr>
<td>Grassy Point</td>
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<td>***</td>
</tr>
<tr>
<td><strong>NOVA SCOTIA</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Point Tupper</td>
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<td></td>
</tr>
<tr>
<td>Flat Head</td>
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<td>*</td>
<td>***</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Bear Head</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Goldboro</td>
<td>***</td>
<td>**</td>
<td>**</td>
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<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>
labor availability are convenient as well. Their proximity to the local power grid and the refinery at Come By Chance are important when considering the sale or generation of boil-off gas.

- Although Long Harbour has an existing jetty (finger pier configuration) it would need to undergo costly upgrades and expansion, limiting its perceived brown-field advantage.
- Point Tupper has access to tugs and support services. Traffic issues, availability of equipment and limited manoeuvrability are likely to increase costs over that of Newfoundland sites.
- Admiral’s Beach, despite having a nearby community supporting labor and a local power grid, has no nearby tug, pilot, emergency and support services.

**Land Area**

- Bear Head and Grassy Point both have sufficient land area that is relatively flat and accommodating for the facility layout.
- Come By Chance’s land is owned by the Federal government and presently committed to the current facilities expansion, limiting the amount of land needed for the facility.
- Where Admiral’s Beach has sufficient land its topographical features create the need for costly land development before a facility could be put in place.
- Long Harbour is extremely limited in the amount of land available for a transshipment and storage facility.
- Point Tupper – Flathead has limited adjacent land with flat contour.

**Environmental Conditions**

- Grassy Point, Point Tupper, and Admiral’s Beach do not have any environmental damage or site preparation liabilities. Grassy Point is located near an aviary zone but delays are not expected as the adjacent plot is occupied by NTL’s approved and constructed oil transshipment facility.
- The available land at Come By Chance has been affected environmentally by the nearby oil refinery and would be subject to costly clean-up and environmental preparations before a facility would be approved for construction.
- Likewise, Long Harbour has severe environmental contamination from the phosphorous plant that previously occupied the site. Associated liabilities and costs would be abnormally high.

Based on these characteristics and subsequent business-development assessments, Newfoundland LNG Limited has determined that Grassy Point is the preferred site. There are significant advantages to being close to, but independent from the two existing and similar marine operations. Their close proximity to Grassy Point will allow possible synergies in the areas of bunkering, emergency response, tugs and markets.
Detailed Asset Evaluation

Description of Grassy Point Site - Terrestrial Physical Environment:

The Grassy Point site extends from Grassy Point in the south, to Whiffen Head in the north, both of which are small headlands. The site is undeveloped and the closest access (within 2 km) is by a gravel road servicing the nearby Placentia Bay Vessel Traffic Service (VTS) radar at Arnold’s Cove.
Grassy Point is a rocky headland with rocky shorelines backed by steep bedrock cliffs. On the left side of the picture, the shoreline consists of a long gravel beach backed with bedrock and unconsolidated banks or cliffs. Immediately to the north of Grassy Point, on the right side of the picture, is a smaller gravel beach backed, for the most part, by a low bedrock cliff.

On the landward side, Grassy Point is an isolated rocky hill about 24 m high. Behind the shoreline, eastwards for a distance of about 600 m, a gently rolling mixed rocky and bog
countryside leads to a series of plateaus of increasing elevation. These culminate in a 77 m hilltop, where the CCG vessel-traffic monitoring remote-radar site is located behind the town of Arnold’s Cove.

The area straddles the outer edges of both the established NTL facility and the municipality of Arnold’s Cove. Marine and onshore lands are Provincial Crown Lands and municipal land recently purchased by NLNG.

Marine Physical Environment

Information on the marine physical environment at Grassy Point is based upon measurements and observations at locations in the immediate vicinity of Grassy Point and/or other locations in Placentia Bay and presents a regional description of the environment representative of the conditions to be encountered at Grassy Point. The features of the marine physical environment which are important for facility design are summarized below. The parameters of the marine physical environment constitute the impact of the environment on the project. The facilities and operations will be designed to accommodate the variances in the marine physical environment.

Bathymetry

Placentia Bay is a major embayment of the south coast of Newfoundland, bounded on the west by the Burin Peninsula and on the east by the Avalon Peninsula. The axis of the bay lies in a north-north-easterly sense, with its opening to the Atlantic Ocean at the Southwest. The bay faces onto the Western reaches of the Grand Banks of Newfoundland. The opening at the mouth of the bay is about 87 km wide, with a depth at the middle of about 240 m, shoaling toward the shore. The distance from the mouth of the bay at Cape St. Mary’s to the head of the bay at Come
By Chance is about 143 km. Placentia Bay contains numerous islands and shoals. The eastern half of the bay is characterized by a well-defined channel, Eastern Channel, with depths of typically 200 m, which run from the mouth almost to the head of the bay. The western half of Placentia Bay is characterized by numerous banks, shoals, and reefs. The top end of the bay contains several islands, the largest being Merasheen Island, Long Island, and Red Island. Because of the orientation of its mouth, Placentia Bay is exposed to winds, waves, and currents propagating in from the Atlantic Ocean.

Water depth at the potential Grassy Point terminal site drops to 10 m within 100 m off shore and then more gradually to 30 m within 400 m off shore and to 125 m or more near the middle of the Come By Chance shipping lane.

**Air Temperature**

Air temperatures at Grassy Point can span a broad range from –29°C to 29°C. Daily mean temperatures range from –5°C in winter to 15°C in summer. The annual daily mean temperature is approximately 5°C. On average, daily temperatures range from about –9°C to –1°C in January and February, and from about 10°C to 19°C in July and August.

**Precipitation**

Monthly total rainfall at Grassy Point will be approximately 60 to 90 mm in the winter and 90 to 125 mm in the summer. Mean monthly snowfall totals will range from 20 to 50 cm in the winter months from December to March. Annual precipitation totals (which include the water equivalent to snow, usually taken as the measured amount divided by ten) of approximately 1300 mm may be expected. Annual snowfall totals will be 120 to 170 cm. Daily rainfall totals as high as 100 mm are possible. The greatest daily snowfall ranges between 30 and 70 cm in the winter. From May to November, rainfalls greater than 0.2 mm can be expected at least 10 days each month. Snowfall greater than 0.2 cm can be expected from three to five days each month in the winter.

**Visibility**

Reduced visibility due to fog and low ceiling is common at the head of Placentia Bay from April to September. In July, visibility can be reduced to 0.5 nautical miles or less up to 40 percent of the time. Visibility conditions at Argentia indicate that limited ceiling 90 m or less occurs at least 5 days on average each month, at least 19 days on average in July, and may occur as frequently as 27 days in June or July. On average, approximately half the days in summer experience ceilings less than 90 m. Visibility which is severely restricted to less than 0.1 km occurs less than one day a month on average for most of the year at Argentia but from May to August may occur from two to five days in a given month on average. Occurrences of visibility reduced to less than 0.1 km may be expected on up to 16 days in July. Visibility is reduced to less than 0.1 km for as much as 5 percent to 8.3 percent of the time in the summer at Argentia.
Wind

Winds at Grassy Point are predominantly from the southwest in most months. On an annual basis, approximately 28 percent of the winds are from the southwest and 15 to 20 percent are from each of the northeast, south and northwest; northeast winds are slightly more prevalent in winter. Monthly mean hourly wind speeds range from about 5 m/s in July to 7 m/s in December (based on conditions measured at nearby Arnold’s Cove). Maximum wind speeds range from 18 m/s to 22 m/s in the spring and summer and from 23 m/s to just less than 26 m/s during the fall and winter. The upper 95 percent wind speed limit ranges from 8.6 m/s in July to 14.2 m/s in December.

Waves

Waves at Grassy Point will be less than 1 m for more than 90 percent of the time. Largely due to the sheltering at this site, near-calm conditions may be expected approximately 40 percent of the time. Waves are not expected to exceed 0.5 m more than 25 percent of the time from May to September. Larger waves up to 2.5 m may propagate into the area from the southwest. The 10 year and 100 year return period significant wave heights are 3.0 m and 3.5 m respectively.

Grassy Point is sheltered from open water from the northeast through the east and south, and has fetches of approximately 42, 13, 4 and 6 km to the southwest, west, northwest and north, respectively.

Tides

The mean tide range at Grassy Point is 1.62 m. The large tide range is 2.47 m.

Currents

Currents in the area are weak and variable with speeds in the range of 5 cm/s to 30 cm/s. A maximum speed of 50 cm/s has been measured on one occasion outside the mouth of the shipping lane approaches to Come By Chance. The general surface circulation pattern in Placentia Bay is counter-clockwise, with an inward flow along the eastern shore and south-westerly flow out the western shore, however, measurements indicate the current flow also exhibits diverse directions at the head of the bay (i.e. near Grassy Point).

Ice

Locally-formed land fast ice of only a few centimetres thickness may occur at the head of Placentia Bay in mid to late March for a period to exceed one week.

The occurrence of sea ice is an occasional event in Placentia Bay. Ice concentrations are rarely greater than a trace: in 1961 and 1987, concentrations greater than 3/10 coverage and in some places as high as 9/10 coverage were observed; however, concentrations of ice this great are extremely unlikely to occur at the head of the bay. If it does occur at the head of the bay, it may
arrive as early as the week of 26 February and depart as late as 14 May. Ice is unlikely to be present for more than five weeks in Placentia Bay in any one year, and unlikely to persist continuously for more than three weeks.

Icebergs are extremely unlikely to drift to the head of Placentia Bay or near Grassy Point. Icebergs have been sighted in the Eastern Channel and near Argentia and are more likely to appear near the mouth of the Bay. Only once since 1960 have greater than eight icebergs entered the Bay (32 in 1961). In some years there are from one to three icebergs, in most years, there are none.

**Icing Potential**

There is potential for moderate to severe vessel icing approximately 5 percent of the time in the winter months at the head of Placentia Bay.

**Tug Boats**

Two or three tug boats will be required to help manoeuvre and secure shuttle tankers and second leg tankers at the terminal. These tugs will have tanker towing and fire fighting capability. Newfoundland LNG Limited is investigating the possibility for the Transshipment Terminal to share the tugs that are used by the North Atlantic Refinery and Newfoundland Transshipment Facility (NTL).

**Ancillary Activities – Vessel Traffic Management**

Vessel traffic in Placentia Bay is presently strictly controlled by the CCG Marine Communications and Traffic Services (MCTS) Centre located at Argentia. The MCTS centre uses state-of-the-art electronic equipment including a network of radar facilities at Arnold’s Cove, Argentia, and Cuslett on the eastern side of Placentia Bay.

Vessel routing is divided into published inbound and outbound traffic lanes starting 10-15 nm southwest of Cape St. Mary’s at the mouth of Placentia Bay and leading up the Eastern Channel of the bay to the port at Come By Chance Harbor. The navigable portion of the bay is divided into zones for the purposes of pilotage. In Zone A at the head of the bay, pilotage is compulsory for all commercial vessels. In Zone B in the Eastern Channel, pilotage is compulsory for all vessels greater than 223 m in length. In the open area in the mouth of the Bay, vessels are regulated by MCTS but pilotage is not compulsory. Vessels in the system must report their positions to MCTS at ten prescribed points along the defined traffic routes.

Vessel maneuvering approach to Grassy Point would be similar to the present marine operations at Come By Chance and NTL. All vessels operating in this part of Placentia Bay are controlled by MCTS in Argentia and follow the established vessel traffic lanes along the Eastern Passage between Cape St. Mary’s and the head of the bay.
Providing visibility and sea conditions are good, the approach to and departure from Grassy Point would consist of the following typical steps. These steps are yet to be reviewed with regulatory authorities in light of the sophistication of the LNG tankers:

- End of sea passage will occur when the inbound tanker enters the two way Traffic Separation System (TSS) at the junction west of Cape St. Mary’s;
- The tanker will proceed northwards following the TSS towards the pilot boarding station east of Red Island at full maneuvering speed (10 to 12 knots). Tankers slow to about 6 knots to pick up a pilot;
- Loaded tankers must be escorted by a tug from this position northwards. There is currently no need for loaded southbound tankers to have an escort tug;
- From Red Island northwards the inbound tanker will navigate within the one-way TSS at full maneuvering speed. Traffic is only allowed to proceed through Eastern Passage in one direction at a time;
- While in the regulated TSS, inbound and outbound tankers must report their positions to Argentia VTS at pre-determined locations;
- At about 2 nautical miles from the jetty, the inbound tanker will slow to a speed of 5 to 6 knots in order to make fast the escort tug. The shuttle tankers, with their thrusters and propulsion design, will be able to safely maneuver with one tug;
- The inbound tanker, with tug, will then head towards the berth progressively slowing down, using the tug to maintain steerage way as the speed drops to 2 to 3 knots;
- The tanker will gradually be brought to zero speed heading towards the jetty at an angle of about 10° at a distance of about one ship length and slightly to the south of the berth. Tugs will be made fast at both ends. Allowances will be made for the wind and current conditions at the time of berthing;
- The tanker will be turned slowly to starboard so that it faces outward (south) before coming into the berth. Once turned, the vessel will be brought gently to the berth at an approach speed less than the maximum design velocity of the berth using the tugs to control angle and velocity;
- Departure operations are much simpler as the vessel will already be facing in the right direction. The loaded second leg tanker, with a pilot onboard, will be pulled off the berth by the two tugs and then will maneuver under its own power. The tugs will be retained until the stern is clear of the berth. Departure speed is 10 to 12 knots all the way south to Argentia where the pilot and escort tug will be released.


Regulatory Overview

**Regulatory Approval Framework:**

Federal Environmental Assessment Process

The Federal Environmental approval process will largely be guided by the Canadian Environmental Assessment Act (CEAA) as this project will qualify under the Law List Regulations (CEAA, Section 5(1)) (i.e. this type of Marine Project requires a federal permit, licence or approval). The marine terminal facility will be designed to handle vessels of larger than 25,000 DWT, which is the criterion in Section 28(c) of the Comprehensive Study List Regulation pursuant to CEAA which results in a comprehensive environmental assessment study being required. Four primary federal entities will be involved in the CEAA study and release process including, the Canadian Environmental Assessment Agency, the Department of Fisheries and Oceans (DFO), the Canadian Coast Guard (CCG) and Transport Canada.

Given the marine nature of the project, the Department of Fisheries & Oceans (DFO), as part of its responsibilities under the CEAA, will act as Responsible Authority (RA) under the Federal CEAA along with the Canadian Environmental Assessment Agency. Consistent with its role as RA under CEAA, the DFO will provide Terms of Reference for the comprehensive environmental assessment study and in conjunction with the Canadian Environmental Assessment Agency will ultimately evaluate. Consistent with its role as RA under CEAA, the DFO will provide terms of reference for the comprehensive environmental assessment study and in conjunction with the Canadian Environmental Assessment Agency will ultimately evaluate the study and project. In addition to its oversight responsibilities as the RA, the DFO will make a determination regarding the environmental impact to associated wildlife habitats as a result of the project. The first step in this process is for the DFO to determine that the project may represent a Harmful Alteration, Destruction, or Disruption (HADD) of wildlife habitats. Based on preliminary conversations with the DFO, we believe that our project, like all of the other similar marine projects to date, will require a HADD assessment and associated DFO review.

As a result of the contemplated pier construction and anticipated usage, the Canadian Coast Guard (CCG) will evaluate multiple aspects of the project including shipping and overall safety. The marine pier will require a Navigable Waters Permit, pursuant to the Navigable Waters Protection Act (NWPA). In addition, the Technical Review Process of Marine Terminal Systems and Transshipment Sites (TERMPOL), a CCG review process that applies to new transshipment facilities, will apply to this project. It is not a regulatory process nor does it replace any assessment process or permitting requirements. The requirements of TERMPOL are broadly based, focusing on operational ship safety (including accidental events), route safety, as well as environmental concerns associated with the location, construction and operation of terminals. The proponent’s submission under the TERMPOL review process will be distinct from the comprehensive environmental assessment study. Information in the comprehensive environmental assessment study may be submitted under TERMPOL as supporting information, but it is not intended that the comprehensive environmental assessment study fulfill all of the information requirements of TERMPOL.
Provincial Environmental Assessment Process

The Newfoundland LNG transshipment terminal project must be registered under the Provincial Assessment Process. Schedule 1 of the Environmental Assessment Regulations (1984) pursuant to Newfoundland Environmental Assessment Act (NEAA) indicates that the establishment of a petroleum products storage facility having a total capacity greater than 2,000,000 L requires registration. The provincial evaluation and process will largely piggy-back the federal process in terms of analysis and assessments.

Federal & Provincial Regulatory Permits and Authorizations

The release of this project under the NEAA or CEAA does not constitute approval to proceed. The proponent is required to comply with all relevant regulatory and permitting requirements. For this project, the proponent would be required, as outlined below, to secure the permits, authorizations and approvals listed.

Table 1 contains a list of all anticipated permits/authorizations that will be required by NLNG for the development of the Newfoundland LNG transshipment terminal project. All the appropriate permits and authorizations will be obtained, and are regarded as existing mitigative measures in place to ensure project safety and environmental acceptability.

Permits and Approvals that May Be Required for Grassy Point LNG Transshipment and Storage Terminal

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<thead>
<tr>
<th>Permit, Authorization, Approval</th>
<th>Agency</th>
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<tr>
<td>Release under the CEAA</td>
<td>Various Federal Departments</td>
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<tr>
<td>Authorization for Works or Undertakings Affecting Fish Habitat (HADD)</td>
<td>Fisheries and Oceans Canada</td>
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<tr>
<td>Permit for Construction within Navigable Waters</td>
<td>Transport Canada</td>
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<tr>
<td>Application for a Water Lease</td>
<td>Transport Canada</td>
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<tr>
<td>Notification to Handle or Transport Dangerous Goods</td>
<td>Transport Canada</td>
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<tr>
<td>Transportation of Dangerous Goods</td>
<td>Transport Canada</td>
</tr>
<tr>
<td>Approval for Vessel Admission</td>
<td>Canada Customs and National Revenue</td>
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<td>Temporary Magazine License</td>
<td>Natural Resources Canada</td>
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<td>Radio Station License</td>
<td>Industry Canada Communications</td>
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<tr>
<td>Application to Import Natural Gas/LNG</td>
<td>National Energy Board</td>
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<tr>
<td>Release under the EPA</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Environmental Assessment Division</td>
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<tr>
<td>Certificate of Approval for any Industrial Processing Facility</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Industrial Engineering Division</td>
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<tr>
<td>Certificate of Environmental Approval for any Alteration to a Body of Water</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Water Resources Division</td>
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<tr>
<td>Water Use Authorization</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Water Resources Division</td>
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<tr>
<td>Shoreline Reservation- Lands Act Section 7</td>
<td>Newfoundland and Labrador Department of Environment and Labour – Lands Division</td>
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<tr>
<td>Letter of Advice of New Construction Project or Industrial Enterprise</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Occupational Health and Safety Services</td>
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<tr>
<td>Permit, Authorization, Approval</td>
<td>Agency</td>
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<tr>
<td>Certificate of Approval for Water Distribution System</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Environmental Management Division</td>
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<tr>
<td>Certificate of Approval for Sewer Works off site</td>
<td>Newfoundland and Labrador Department of Environment and Labour - Environmental Management Division</td>
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<tr>
<td>Permit for Access off any Highway</td>
<td>Newfoundland and Labrador Department of Works, Services and Transportation - Transportation Regulation Enforcement</td>
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<tr>
<td>Authorization to Handle or Transport Dangerous Goods</td>
<td>Newfoundland and Labrador Department of Works, Services and Transportation - Transportation Regulation Enforcement</td>
</tr>
<tr>
<td>Borrow and Quarry Permit</td>
<td>Newfoundland and Labrador Department of Natural Resources - Mineral Lands Division</td>
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<tr>
<td>Authorization to Control Nuisance Animals</td>
<td>Newfoundland and Labrador Department of Forest Resources and Agrifoods - Wildlife Division</td>
</tr>
<tr>
<td>Permit to Burn</td>
<td>Newfoundland and Labrador Department of Forest Resources and Agrifoods - Forest Fire Protection</td>
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<tr>
<td>Commercial Cutting Permit</td>
<td>Newfoundland and Labrador Department of Forest Resources and Agrifoods - Newfoundland Forest Service</td>
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<tr>
<td>Operating Permit</td>
<td>Newfoundland and Labrador Department of Forest Resources and Agrifoods - Newfoundland Forest Service</td>
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<tr>
<td>Certificate of Approval for Storage and Handling of Gasoline and Associated Products</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Food Establishment</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Certificate of Environmental Approval to Establish, Alter, Enlarge or Extend a Waste Management or a Waste Disposal Site or Incinerate</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Approval for Water Supply System</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Letter of Approval – Septic System</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Approval for Sewage Disposal System</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Approval to Inhabit Bunkhouse</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Operations Division</td>
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<tr>
<td>Certificate of Approval for Commercial Septic System in an Unserviced Area</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Engineering Services</td>
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<tr>
<td>Review of Building/Fire/Life Safety</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Engineering Services</td>
</tr>
<tr>
<td>Permit for Pressure Piping System</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Engineering Services</td>
</tr>
<tr>
<td>Permit for Flammable and Combustible Liquid Storage and Dispensing and for Bulk Storage</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Engineering Services</td>
</tr>
<tr>
<td>Building Accessibility</td>
<td>Newfoundland and Labrador Department of Government Services and Lands - Engineering Services</td>
</tr>
<tr>
<td>Permit for Archaeological Investigations</td>
<td>Newfoundland and Labrador Department of Tourism, Culture and Recreation - Historic Resources Division</td>
</tr>
<tr>
<td>Approval for Waste Disposal</td>
<td>Town/Community Council</td>
</tr>
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</table>
Engineering Analysis

The marine terminal will consist of a series of three berths. Each berth will be capable of berthing a 265,000 m$^3$ and 140,000 m$^3$ LNG vessel. The construction of the three berths will be phased in over the duration of the Project. A single berth will be initially constructed, followed by additional berths as the LNG demand increases.

Each berth will be similar in construction and will consist of a service platform, mooring dolphins, berthing dolphins, access trestle connecting the loading platform to shore and walkways connecting the mooring and berthing dolphins. The service platform will be equipped with fixed loading arms to facilitate loading and unloading of LNG.

Aerial view of Grassy Point Peninsula with Approximate Footprint of the Project showing the Newfoundland Transshipment Terminal and North Atlantic Refinery in the Background
The berthing structures will be located in approximately 15 m of water such that there is sufficient draft, thereby eliminating the requirement for dredging. In-water blasting is not required.

The tug basin will require a minimum of 6 m water depth and be capable of berthing two to three tugs. Dredging may be required for the tug basin, but the material will be disposed of on land.

**Berths**

The three berths will include facilities for the receiving and unloading of LNG cargo from LNG tankers. The piers will have safety design features including quick disconnect unloading arms and catch basins.

Each berth will be constructed with the following structures and features:

- service platform approximately 30 m x 30 m;
- two berthing dolphins approximately 9 m x 12 m;
- four mooring dolphins approximately 6m x 8 m;
- steel truss catwalks connecting the dolphin structures;
- access trestle capable of carrying vehicle traffic and LNG pipe racks;
- quick release mooring hooks;
- spill containment equipment;
- fire fighting equipment and fire monitors; and
- electrical supply and lighting.

Each berth will have four mooring dolphins; two on either side. The mooring dolphins are designed to withstand forces created by wind, waves and currents on the LNG tankers. These will accommodate:

- triple quick release hook assemblies with powered capstans; and
- handrail and bull rails.

Each berth will have two berthing dolphins which are designed to absorb the berthing forces of the LNG tankers. The berthing dolphins will be equipped with energy absorbing fenders.

**Sub-Structure**

The sub-structure support for the service platform, dolphins and access trestle will be steel-pipe-piles which are driven into the bedrock and grouted to the pile caps. An optional structural configuration would utilize pre-fabricated steel jackets. Both of these systems are currently in use at the Newfoundland Transshipment facility. The final selection of the structural system will be determined upon completion of the geotechnical surveys, engineering design and costing exercises.

All piling will consist of steel pipes which are driven/drilled into the bedrock. Piles under tension loads will have to be fixed to the seabed by grouting anchors into the pile annulus and drilling
and grouting the anchors into the bedrock. All drill cuttings will be returned to the drilling barge and discharged onshore in accordance with regulatory requirements.

Superstructure
The superstructure of each of the marine structures will consist of a combination of pre-cast concrete elements combined with in-situ concrete. Concrete bases will be provided for mechanical equipment. Handrails and bull rails will provide protection along the perimeter of the service platform, mooring dolphins and berthing dolphins.

Service Platform
Each service platform will be equipped with five loading arms. The LNG and vapor flow path with the vessels is accomplished with standard 400 mm (16 inch) arms typical of the industry. The 15,000 m³/hr flow rate will require the use of five arms. Three arms will be dedicated for LNG flow and one for vapor return. One will be dual liquid/gas service. The 400 mm arms will interface directly with typical LNG vessels and will be fitted with 500 x 400 mm reducers if the Q-max vessels are in fact fitted with 20 inch headers.

Each berth will have up to five arms together with its hydraulic power unit and emergency disconnect devices/couplings. Automated alignment systems are included to improve safety and reduce preparation time at berth.

The service platform will be accessible for vehicle traffic and will be equipped with a control station, pipe racks and fire fighting equipment.

The service platform will also be outfitted with mooring hooks to handle the vessel spring lines.

The service platform will also accommodate the loading docks. The loading docks are designed to accommodate the following:

- control rooms;
- cranes;
- lighting and electrical distribution systems;
- navigational aids;
- cathodic protection;
- communications equipment;
- fire detection and fire fighting equipment;
- gas detection systems;
- gangways;
- dry chemical storage;
- LNG offloading arms;
- vapour loading arms;
- hydraulic power units with accumulators; and
- control building.
Access Trestles

An access trestle will serve to provide a support system for the pipe racks, mechanical systems, electrical trays and vehicle traffic. The trestle lengths will vary with each berth. The overall width will be sufficient to provide one way vehicle traffic, pedestrian right of way, pipeline and other utilities.

Trestles will be constructed of steel plate girders with pre-cast deck elements. Piping and utilities will be supported by a steel truss structure. The trestle will be supported on a concrete pile cap supported on steel pipe piles. Elastomeric bearing pads will be provided under each of the trestle bearing points.

Access Walkways

Steel truss walkways will link the service platform, berthing dolphins and mooring dolphins. The walkways will also carry the cable trays for electrical conduits for power and navigation aids.

Onshore Component

The primary code requirements for the design and layout of the LNG storage tanks is Canadian Standards Association Z276-01 “Liquefied Natural Gas (LNG) – Production, Storage, and Handling”, which has just been updated to include more conservative computer-based risk modeling requirements. Also important is the U.S. code of the National Fire Protection Agency (NFPA 59A) that is used to define the fire safety and prevention aspects of the facility design. The key portions of the code that affect tank spacing and hence land usage are the thermal radiance and vapour cloud dispersion requirements.

The dominant factor in the overall layout of the land-based portion of the facility is the location of the LNG storage tanks. Standards and codes define the allowable spacing between tanks and the allowable proximity of other facility structures and equipment as well as the allowable impact (in the unlikely event of an accidental release or fire) upon neighboring lands that may be occupied and with no access control by the terminal owner. A key factor in this spacing determination is the size and design of the individual LNG tanks.

The onshore portion of the terminal will cover an area of approximately 176 hectares. The facility will consist of a tank farm of 8 storage tanks, interconnecting flow lines, re-liquefaction equipment, support facilities, a waste water handling system and a fire protection system. Transfer pumps might be avoided if sufficient tank elevation (20 to 40 m) can be established to take advantage of gravity feed to load tankers; booster pumps may be used if the transfer pumps have insufficient discharge pressure. The facility will be designed for LNG ship-to-ship transfers, storage and reloading onto LNG tankers for transshipment to market destinations. Treatment facilities for ballast water will not be required as the tankers will have segregated ballast that will not contain hydrocarbons. Monitoring of these segregated ballast systems will be part of preventative ship maintenance, which is one of the standards for vetting second-leg tankers for use at the transshipment terminal. The facilities will include onshore and jetty fire fighting capability and on-site spill containment and clean-up equipment.
LNG Storage Tanks

The LNG storage tanks incorporated into the design basis for all Stages are 160,000 m$^3$ gross capacity and of single containment design. This size was selected for compatibility with the majority of the LNG vessel fleet in operation and in design/build. They are currently being built by multiple vendors. The single containment design is the most conservative in terms of meeting standards and design codes since it will require the most fire safety and the widest spacing from other structures and from the property line. The use of double or full containment designs will fall well within these parameters, most notable is the layout spacing. Ultimately, the total number of tanks at the site will be eight, providing up to 1.1 million m$^3$ of LNG storage.

Each tank will be capable of handling 15,000 m$^3$/hr flow rates in and out and will generate a BOG volume of 0.05% of its volume daily (80 m$^3$/day = 3.3 m$^3$/hr liquid = 1,980 m$^3$ of natural gas). The tanks will operate at a maximum pressure of 2.0 psi. Each tank will be equipped with three submerged pumps capable of delivering a combined 15,000 m$^3$/hr. BOG will be sent to the re-liquefaction system that will return the volume back to the tank.

The tanks will be field erected on foundations designed to preclude thermal frost heave either with the design of an air-gap foundation or use of a heated pad. The materials will be brought to the site via the construction dock in pre-assembled pieces as large as can be accommodated by barge and the site.

Surge tanks

Two vacuum insulated LNG surge tanks will be installed, one for the output of the LNG re-liquefaction systems and one for the suction of the LNG booster pump. The vacuum insulation creates a “thermos bottle” type of protection against heat gain resulting in virtually no contribution to the over process system heat gain. These tanks will be brought to site from the fabricators shop as a complete unit.
The site plan for the full build-out (8 tanks and 3 piers) of the Grassy Point LNG Transshipment and Storage Terminal is presented below.

**Facility Design:**

Newfoundland LNG is in the process of soliciting proposals and bids for a detailed engineering design study for possible alternate development concepts. At this time, a preliminary conceptual design has been developed by SNC Lavalin for the Newfoundland LNG transshipment terminal. Once an engineering design contractor has been selected, a more detailed design will be determined. Detailed engineering for both the onshore and offshore facilities will consider the degree of integration with existing facilities at the North Atlantic Refinery marine operations and the Newfoundland Transshipment Facility.

The facility will be designed for an initial operating period of 50 years. National and international standards as well as the company established policies will be incorporated into the design. All applicable federal and provincial regulations will be adhered to. The core principles governing the operation of the facility will be safety, environmental protection and efficiency.

The design of the facility is discussed below in terms of marine and onshore components. The picture below illustrates a general layout of the prospective facility at Grassy Point.
**Marine Facilities:**

The marine facilities will consist of an approach causeway, trestle and jetty with berthing and marine topside facilities. Detailed engineering will review and select the appropriate jetty construction technology. Technologies under consideration include concrete caissons, steel piles and/or steel sheeting; final selection will depend on many factors including bathymetry, geotechnical conditions, environmental concerns and economics.

The facilities will initially be constructed to handle two tankers at a time. The aerial extent of a single jetty will be approximately 370 m x 60 m. The facility will be designed to accommodate an additional two berths in the future. Specifics of the construction sequencing will be established in the detailed design phase. A causeway and trestle will join the jetty with the onshore portion of the facility. The seafloor footprint of a rock causeway will be about 70 m wide and some length less than 600 m which has yet to be confirmed by detailed design. The jetty will consist of a series of mooring dolphins connected by a trestle roadway or catwalk. The tanker will be berthed at a central loading platform and moored to the dolphins on either side. Water depth at the tanker berth will be about 30 m. Each berth will be capable of handling vessels from 140,000 DWT to 250,000 DWT. The final layout will be determined during detailed design.

The terminal will be served by a dock crew, and at least two tugs which will be used to assist tanker docking and departures.

The terminal will typically be notified about seven days in advance of the arrival of long haul tankers and two days in advance of the arrival of a shuttle tanker. Average lay time for delivery and redelivery of LNG is not expected to exceed twenty-four hours after the arrival of the shuttle tanker or long haul tanker at the berth.
**Onshore Facilities:**

The onshore portion of the terminal will cover an area approximately 62 ha. The facility will consist of a tank farm, interconnecting flow lines, support facilities, a waste water handling system and a fire protection system. Transfer pumps might be avoided if sufficient tank elevation (20-40 m) can be established to take advantage of gravity feed to load tankers; booster pumps may be used if the transfer pumps have insufficient discharge pressure. The facility will be designed for LNG STS transfers, storage and reloading onto LNG tankers for transshipment to market destinations. Treatment facilities for ballast water will not be required as the tankers will have segregated ballast which will not contain hydrocarbons. Monitoring of these segregated ballast systems will be part of preventative ship maintenance, which is one of the standards for vetting second-leg tankers for use at the transshipment terminal. The facilities will include on-site onshore and jetty fire fighting capability and on-site spill containment and clean-up equipment.

**Project Timeline:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
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<tbody>
<tr>
<td>Detailed Design Stages</td>
<td>Jan 2006 to May 2008</td>
</tr>
<tr>
<td>Procurement of Equipment</td>
<td>May 2007 to June 2009</td>
</tr>
<tr>
<td>Site Preparation</td>
<td>May 2007 to September 2007</td>
</tr>
<tr>
<td>Construction</td>
<td>June 2007 to October 2009</td>
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<td>Tank Construction</td>
<td>October 2007 to September 2009</td>
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<tr>
<td>Mechanical Completion</td>
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